MAYMEAD ROBY GREENE ROAD

METEOROLOGICAL STUDY

AND

MODELING ANALYSIS

(FINAL)

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Subject: **Meteorology Study – Maymead Roby Greene Road Asphalt Plant**

INTRODUCTION

The purpose of the Maymead Watauga County asphalt plant meteorological study was to provide site specific meteorology that could be used to conduct refined level modeling using available EPA approved models such as ISCST3, AERMOD, and CALPUFF. These models are considered refined level models and provide for more accurate estimates of ambient concentrations in simple and complex terrain than the screening level SCREEN3 model. The results of the refined level modeling analyses were also used to evaluate the relative accuracy and conservatism of the SCREEN3 model in a complex terrain environment that is similar to many current and proposed asphalt plant locations in western North Carolina.

METEOROLOGICAL PARAMETERS

The meteorological instrumentation used to collect data at the Maymead – Roby Greene Rd. site consisted of two 10-meter weather stations located at separate locations; one at the proposed site referred to as the valley site, the other approximately 400 meters to the east of the facility and referred to as the hill site. The following meteorological parameters were collected at each station:

A) ambient temperature at 2 and 10 meters
B) relative humidity
C) solar radiation
D) barometric pressure
E) wind speed and direction at 10m
F) precipitation

The instrumentation was powered by 110-volt current and parameters were sampled approximately every 2.5 seconds to provide a 1-hour average (1-hour total for precipitation and solar radiation). Sigma-theta was calculated for wind direction to provide hourly stability categories.

The data-logger was polled via modem on a regular basis for QA/QC checks and data archival. DAQ personnel visited the site on a number of occasions to ensure proper operation and calibration of all systems and to perform equipment repair as needed.

GENERAL DISCUSSION

Most regulatory modeling is conducted using the SCREEN3 and ISCST3 gaussian models to provide conservative estimates of ambient concentrations from one or more emission sources. These models are capable of providing concentration estimates in all terrain conditions including the mountainous environment found in western North Carolina. Modeling in western North Carolina, however, is generally limited to the SCREEN3 model since site specific or representative meteorology data is usually not available. Although SCREEN3 using screening meteorology is generally thought to predict higher impacts than would actually occur, conditions existing at some mountainous locations (e.g., persistent temperature inversions, stagnant weather conditions, calm winds, cold air drainage, terrain slope flows, etc,) may degrade model accuracy and limit the degree of conservatism. ISCST3 and AERMOD using on-site data will provide a more accurate estimate of ambient concentrations, however, like SCREEN3, ISCST3 and AERMOD are steady-state models that may not adequately address all complex terrain concerns.

CALPUFF is a non-steady-state puff dispersion model that can simulate the effects of time and space varying meteorological conditions on pollutant transport. Three-dimensional wind fields are created based on multi or single station wind data and the topography and surface characteristics (e.g., surface roughness, albedo, etc.) within the modeling domain. CALPUFF can also assess pollutant impacts under stagnant (calm wind) conditions and through the use of the CALMET model can account for the kinematic and blocking effects and slope flows of the local terrain.

METEOROLOGICAL DATA

The meteorological data collected from each tower was processed with the upper-air meteorological data from Blacksburg, Virginia and formatted for use with the ISCST3, AERMOD, and CALPUFF models. Blacksburg is the nearest upper-air site most representative of the Roby Greene Road area.

The raw meteorological data sets collected at each tower site represent a full year of surface data; however, due to the normal time lag of collecting and processing real time data by the National Climatic Data Center (NCDC), the same year additional meteorological data (surface and upper-air) required to develop the model meteorological data sets were not completely available at the time the raw tower data was initially processed. As a result, the initial model runs conducted for the draft report released in March 27, 2001, hereafter referred to as draft model runs, were based on meteorological records for each model as follows:

ISCST3	Nov 1, 1999 – Aug 31, 2000
AERMOD	Nov 1, 1999 – Aug 31, 2000
CALPUFF	Nov 1, 1999 – Sep 30, 2000

The final report issued July 23, 2001, includes additional modeling, hereafter referred to as final model runs, based on a limited facility operating schedule and the appropriate subset of the full year (Nov 1, 1999 – Oct 31, 2000) meteorological record for each of the models runs.

Wind roses have been developed for each of the two meteorological data sets and are presented in figures 1 and 2. The data represent the full year of data collection – November 1, 1999 through October 31, 2000. Wind roses are diagrams designed to show the distribution of wind direction experienced at a given location over a specified time period (in this case, 1 year). The length of the line is proportional to the frequency of occurrence of wind from that direction. Wind speed categories are color coded, the length of which is also proportional to frequency of occurrence. The percentage of calm winds are calculated and presented in the data summary.

As indicated by the wind roses for each station, winds in the area are predominantly from the west and northwest with a much smaller frequency of occurrence from the east and southeast. The “hill” station shows more winds from the northwest as compared to the “valley” station and is reflective of the specific tower locations. As shown in the CALMET domain terrain elevation map (figure 3), the valley station is located on the plant site and would be exposed to winds funneled through the valley in an almost precisely west-to-east (or vice-versa) direction. The hill station, however, is able to receive winds more from the northwesterly and southeasterly directions. As reported in the data summary for each of the wind roses, the percentage of calm winds is in the 40% to 41% range for each site.

MODEL RUNS

The proposed Maymead Roby Greene Road asphalt plant location is off of Roby Greene Rd. in Watauga County. The site is situated along the south fork of the New River at an elevation of approximately 3,100 feet above mean sea level (MSL) and is located in an east-west oriented river valley bounded to the north and northeast by Chestnut Mountain and to the northwest and south by several hills. The topography is generally mountainous with elevations ranging from approximately 3,000 feet above MSL to over 3,500 feet above MSL within 3 kilometers of the site. The local topography and elevated terrain surrounding the site is depicted in Figures 4 and 5.

The facility will emit several toxics during the production of asphalt, primarily from the emissions-controlling baghouse (dryer), truck loadout, and silo operations. The emission characteristics of each of the emission sources are provided in Table 1. The pollutant emission rates used in the draft and final report model runs are provided in Table 2 and are based on the latest DAQ emissions spreadsheet (attachment 1) for hot-mix asphalt plants (December 2000 final emission factors from Section 11.1 AP-42). A plant capacity of 150 tons per hour (TPH) was assumed, along with an annual production limit of 300,000 tons per year (TPY) of asphalt.

Table 1.

Point Source Parameters

Source I.D.	Baghouse	Silo
Location – Easting (m)	443209.71	443231.618
Northing (m)	4010017.632	4010009.5
Source elevation (m ASL)	946	946
Source height (m)	9.4	13.7
Diameter (m)	.86	.1
Exit Temperature (K)	422	422
Exit velocity (m/s)	24.49	.01
Exit flow rate (acm/s)	14.17	7.8E-5

Volume Source Parameters

Source I.D.	Loadout
Location – Easting (m)	443231.618
Northing (m)	4010009.503
Source elevation (m ASL)	946
Release height (m)	4.5
Sigma Y (m)	.813
Sigma Z (m)	.465

Table 2

Toxic Emission Rates*
(lb/hr)

Model Run / Toxic	Baghouse	Loadout	Silo
Draft			
Arsenic	1.92E-05	0	0
Benzene	1.34E-02	7.4E-05	1.34E-04
Formaldehyde	4.65E-01	5.49E-04	1.26E-02
Mercury	3.9E-04	0	0
Nickel	9.45E-03	0	0
Final			
Arsenic	6.45E-05	0	0
Benzene	4.56E-02	4.56E-04	2.53E-04
Formaldehyde	4.65E-01	5.49E-04	1.26E-02
Mercury	3.9E-04	0	0
Nickel	9.45E-03	0	0

* rates based on 150 TPH plant capacity and 300,0000 TPY production.

Draft and Final Model Runs

Using the emissions data shown in Tables 1 and 2, draft and final model runs were performed to evaluate the off property ambient impacts from the proposed asphalt plant. The draft model runs were made assuming the asphalt plant would operate at capacity (150 TPH) for any 1-hour or 24-hour period during the course of the modified year (10 months using ISCST3 and AERMOD, 11 months using CALPUFF) and at a maximum annual capacity of 300,000 TPY. The final model runs were made making the same capacity assumptions but further assumed the plant would only operate from 7 am to 7 pm, April 1 through October 31. Although a full 12 months of surface and upper air meteorological data were available for the final model runs, the limited time frame modeled represents a more realistic or typical operating scenario for an asphalt plant.

The draft model 1-hour and 24-hour emission rates were derived based on the maximum hourly production capacity of the asphalt plant (150 TPH). Annual hourly emission rates were based on total annual facility emissions divided by 8,760 hours which defines the annual pollutant exposure threshold and acceptable ambient level. The assumption made in the annual draft model runs was that the additional 1-hour concentrations not modeled due to the initial lack of additional meteorological data would not result in combined and averaged concentrations significantly different than those modeled using the ten or eleven months of available data. A similar assumption was made regarding the 1-hour and 24-hour draft modeling runs; i.e., the hours not modeled due to the lack of data would not result in maximum modeled 1-hour or 24-hour impacts significantly different than those modeled.

The final model 1-hour and 24-hour emission rates, as with the draft model runs, were derived based on the maximum hourly production capacity of the asphalt plant (150 TPH). Annual hourly emission rates were based on total annual facility emissions divided by the number of hours the facility would operate in one year. For the final model runs, the annual hourly emission rate was based on a 12 hour per day, April 1 through October 31, annual operating schedule which equates to 2,568 hours.

The ISCST3, AERMOD, and CALPUFF models were run using the appropriate processed on-site meteorological data to determine the maximum impact for each pollutant for each averaging period. The same emission data input stream was used in each model input file. Details of each model run are provided below.

ISCST3

The ISCST3 (Industrial Source Complex Short-Term) model was designed to accommodate a variety of emission sources from industrial facilities and is recommended for use by EPA for rural or urban areas, simple and complex terrain, 1-hour to annual averaging periods, and continuous pollutant emissions. ISCST3 can account for source separation and building downwash effects at a facility and uses representative or on-site meteorological data to provide estimates of pollutant concentrations.

Meteorological data requirements for the ISCST3 model include hourly-averaged wind speed and direction, temperature, stability class, and mixing height. The hourly mixing heights are calculated following procedures outlined by EPA using data available from the nearest, most representative National Weather Service station for which upper-air data is available. Upper-air meteorological parameters are fairly homogeneous over relatively large areas and the mixing height calculations involve the use of representative or on-site meteorological data to determine the hourly values.

ISCST3 (00101) was used to evaluate impacts in both simple and complex terrain surrounding the proposed Maymead Roby Greene facility. The three sources shown in Table 2 were included in the modeling. Ten months (Nov. 1999 – Aug. 2000) of meteorological data from the on-site (valley) station with same time frame upper-air data from Blacksburg, VA were used in the model for the draft model runs. Seven months (Apr 1 – Oct 31) on-site data were used in the final model runs. Direction-specific building dimensions, determined using EPA's BPIP program (95086), were used as input to the model for building wake effect determination. Receptors were placed around the facility's property boundary at 25-meter intervals and extended outward to 1.5 kilometers at 100 meter spacing and from 1.5 km to 3 km at 250 meter spacing. Terrain elevations were incorporated for each receptor modeled. Maximum impacts for all toxics occurred in complex terrain. Annual and 24-hour impacts occurred approximately 1 kilometer east of the facility; 1-hour formaldehyde impacts occurred directly to the south (draft) as well as to the east (final).

Maximum impacts for each toxic are provided in the modeling summaries given in attachment 2. The maximum annual impacts in the final model runs were adjusted by the ratio of the modeled hours to the hours in a full year (5136/8760). Annual pollutant impacts must be evaluated over a one year (8,760 hours) period The ratio adjustment was necessary because the ISCST3 model calculated an annual average for the period of meteorological record (April 1 through October 31 or 5,136 hours) and did not factor or average in the hours of the year the facility did not operate and in which the hourly concentrations were zero. Figure 6 shows the impact locations of the maximum ISCST3 modeled concentrations for each pollutant.

AERMOD

AERMOD is a steady-state gaussian model and successor to the ISCST3 model. AERMOD was designed with the goal of introducing current planetary boundary layer (PBL) concepts into regulatory dispersion models. Relative to ISC3, AERMOD currently contains new or improved algorithms for:

1) dispersion in both the convective and stable boundary layers;
2) plume rise and buoyancy;
3) plume penetration into elevated inversions;

4) computation of vertical profiles of wind, turbulence, and temperature;
5) the urban boundary layer; and
6) the treatment of receptors on all types of terrain from the surface up to and above the plume height.

Essentially, AERMOD was developed in an effort to make dispersion modeling more meteorologically sound. The most notable difference in AERMOD is the way in which the atmosphere is represented. By creating a temperature and wind speed profile of the atmosphere, AERMOD graduates beyond the more general temperature and wind speed categories assigned in ISCST3. AERMOD also considers surface roughness, solar radiation, surface reflectivity, and surface moisture to more accurately represent the atmosphere in which a plume is dispersing. With respect to terrain and unlike ISCST3, AERMOD allows split flow around and over elevated terrain and provides a more realistic representation of the dispersion of a plume.

One of the major improvements that AERMOD brings to applied dispersion modeling is its ability to characterize the PBL through both surface and mixed layer scaling. AERMOD constructs vertical profiles of required meteorological variables based on measurements and extrapolations of those measurements using similarity (scaling) relationships. Vertical profiles of wind speed, wind direction, turbulence, temperature, and temperature gradient are estimated using all available meteorological observations. AERMOD was designed to run with a minimum of observed meteorological parameters. As a replacement for the ISCST3 model, AERMOD can operate using data of a type that is readily available from an NWS station. Although AERMOD can use a representative and on-site surface data set, AERMOD requires only a single surface measurement of wind speed (generally at a height of 10m), wind direction and ambient temperature. Like ISCST3, AERMOD also needs observed cloud cover. However, AERMOD also requires the full morning upper-air sounding (RAWINSONDE). ISCST3 required only the morning and afternoon mixing heights derived from the respective morning and afternoon soundings. In addition, AERMOD needs surface characteristics (surface roughness, Bowen ratio, and albedo) in order to construct its PBL profiles.

For the Maymead Roby Greene Road site, AERMOD was run using the on-site (valley) meteorological data, cloud data from Asheville (NWS surface data site), and upper-air data from Blacksburg, VA (NWS upper-air data site). The period of the data was Nov 1, 1999 to Aug 31, 2000 for the draft model runs and Apr 1, 2000 to Oct 31, 2000 for the final model runs. The area around the site was designated as a coniferous landmass with average surface moisture and reflectivity. Annual concentrations were derived based on the entire available period instead of a full year of met data. The terrain processing program, AERMAP, was run prior to AERMOD utilizing 7.5 minute USGS DEM data for the area. All other factors, such as receptors and sources were the same as specified for the ISCST3 model. Except for formaldehyde (draft), maximum concentrations occurred in simple terrain in the vicinity of the eastern property line. Formaldehyde maximum impacts (draft) occurred in the mountains NE of the site.

The maximum impacts for each toxic are provided in the modeling summary given in attachment 2. The AERMOD maximum annual impacts in the final model runs were also adjusted by the ratio of the modeled hours to the hours in a full year (5136/8760). Like the ISCST3 model, AERMOD calculated an annual average for the period of meteorological record (April 1 through October 31 or 5,136 hours) and did not factor or average in the hours of the year the facility did not operate and in which the hourly concentrations were zero. Figure 7 shows the impact locations of the maximum AERMOD modeled concentrations for each pollutant.

CALPUFF

CALPUFF is a non-steady-state dispersion model that can simulate the effects of time- and space-varying meteorological conditions on pollutant transport. The CALPUFF modeling system, which includes the CALMET meteorological model, uses three-dimensional meteorological fields computed by CALMET based on topography, on-site surface meteorological data, and upper-air sounding data from a nearby NWS station. Unlike steady-state gaussian models, CALPUFF can assess pollutant impact under stagnant (calm wind) conditions and through the use of the CALMET model can account for the kinematic and blocking effects and slope flows of the local terrain.

In order to execute CALPUFF for the time period of concern, CALMET must first be run in order to obtain a three-dimensional gridded meteorological data field for each hour. CALMET uses available sources of meteorological and geophysical information to produce a spatially-varying wind field that is consistent with the local terrain features and atmospheric stability conditions at the site. A CALMET terrain pre-processor was used to grid the terrain elevations and land use categories over a 10.2 km x 10.2 km grid surrounding the proposed Maymead facility. Once the meteorological data fields were created, CALPUFF was run to calculate pollutant impacts at each receptor in a 10 km x 10 km grid with 100 meter spacing.

The maximum impacts for each toxic are provided in the modeling summary given in attachment 2. As with ISCST3 and AERMOD and for the same reason, the CALPUFF maximum annual impacts in the final model runs were adjusted by the ratio of the modeled hours to the hours in a full year (5136/8760). Figure 8 shows the impact locations of the maximum CALPUFF modeled concentrations for each pollutant.

MODELING RESULTS

The modeling results for the draft and final refined model runs are presented in attachment 2. The maximum impact locations are shown in figures 6 through 8. The noticeable difference in where the maximum impact is predicted to occur between the refined model results can be attributed to the differences in how each of the models handles complex terrain and the subtle differences between the closer simple/elevated terrain impacts and the more distant complex terrain impacts. Of particular note are the

CALPUFF maximum impact locations. CALPUFF will track each puff of pollutant through each grid cell in the modeling domain and react to the differences in meteorology (e.g., wind direction) in each cell. As suggested by the orientation of the topography and as shown by the wind rose for the hill tower meteorological data, the prevailing westerly winds at the emissions site become more northwesterly downwind or east of the facility. As a result, the puffs of pollutant change course as they move downwind causing maximum impacts to occur on the hills southeast of the facility as well as the east.

The original and revised SCREEN3 model results using the latest EPA emission factors are also presented in attachment 2. The first or original SCREEN3 results were submitted with the initial permit application in May 1998 and reflect emissions based on existing AP-42 emission factors and DAQ test results. The second SCREEN3 model results were based on updated EPA asphalt plant emission factors derived in March 2000. The third or final SCREEN3 model results presented reflect revised EPA emission factors derived in December 2000. The draft and final refined model runs, including CALPUFF, show maximum predicted impacts for each pollutant for each averaging period to be less than the respective pollutant AALs and, with the exception of the draft CALPUFF formaldehyde impacts, to be less than the SCREEN3 maximum predicted modeling results.

CONCLUSIONS / RECOMMENDATIONS

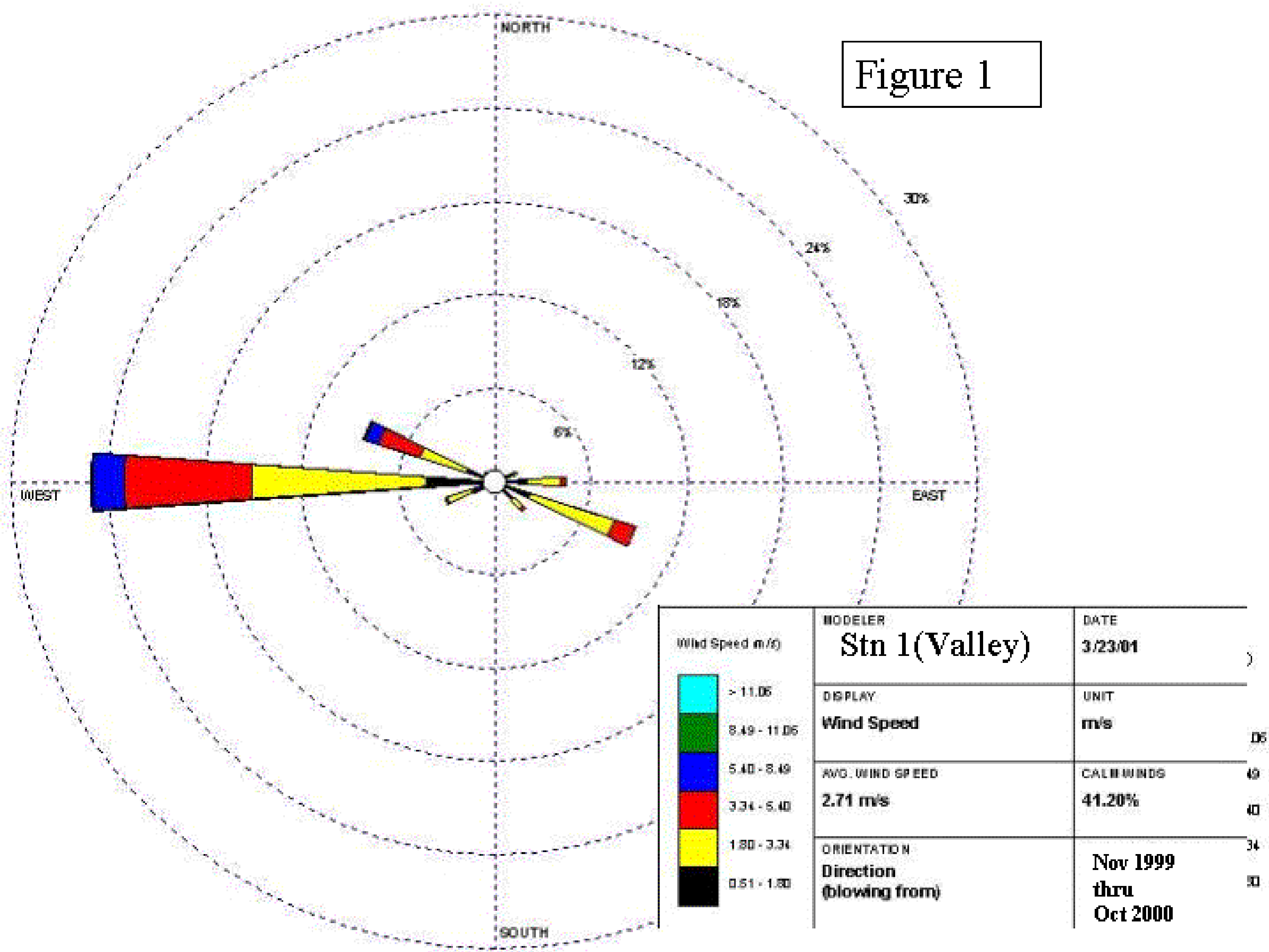
The draft and refined model results using site specific meteorology and source emissions based on a plant capacity of 150 tons per hour and an annual production limit of 300,000 tons of asphalt indicate the proposed Maymead Robey Greene Road asphalt plant would operate in compliance with the applicable AAL for each of the pollutants evaluated.

Due to the unique meteorological conditions and terrain influences existing in mountainous terrain such as that in western North Carolina, dispersion modeling becomes a more difficult process where model deficiencies and uncertainties are more readily apparent. As a result, caution should be taken in extrapolating the results of this study to other mountainous locations that may generate different modeling results and conclusions. However, based on the refined modeling results discussed above and recognizing that the option of not permitting any industrial facility in western NC due to these uncertainties or requiring every facility to collect on-site meteorology and conduct refined level modeling are unlikely scenarios and until additional mountainous location site specific data can be acquired and used in refined modeling analyses to further evaluate the effects of complex terrain and plume transport interaction, we recommend the following:

We believe the meteorology and terrain influences of this site are characteristic of mountainous terrain in general and as such believe the SCREEN3 model can be used, on a case-by-case basis and with certain caveats, to evaluate maximum impacts for facility toxic emissions in mountainous terrain. In addition to determining compliance for the proposed asphalt plant, the collection of meteorological data and subsequent refined model runs as discussed above were also used to evaluate the relative accuracy and conservatism of the SCREEN3 model in a complex terrain environment in western North Carolina. As previously stated, we acknowledge that the specific modeling results and model comparison percentages presented in this study apply only to the data collection site. We also acknowledge that SCREEN3 (or for that matter, any screening model) is not the best model to use to determine pollutant ambient impacts at any given location in mountainous terrain and that one could expect poor correlation between observed and predicted values; however, the draft and final refined model results do suggest the SCREEN3 model may provide, in most cases, conservative estimates of maximum ambient impacts in such terrain. This is particularly true for annual pollutants where the technical enhancements incorporated in such models as AERMOD or CALPUFF are somewhat diminished in the long term averaging process. Also note: the regulatory modeling process is most concerned with ensuring the maximum modeled ambient impacts are less than the applicable air quality standards and not with the specific impacts at any one location. When using SCREEN3, we would recommend a conservative modeling methodology; e.g., one that would combine maximum impacts from all the sources evaluated and use the highest 24-hour and annual conversion factors. We would also recommend that for 1-hour pollutant impacts greater than 50% of the applicable air quality standard or AAL or for certain terrain influences, e.g., steep terrain contour gradients, diverging/converging valley orientations, etc., further evaluation should be conducted to include, as necessary, additional model runs using such models as CTSCREEN or AERMOD (screening mode) to compare/confirm the SCREEN3 results.

We also recommend that the AQAB continue to evaluate options which would allow the use of state of the art models such as AERMOD and CALPUFF in western North Carolina and which would minimize the time consuming and expensive process of collecting on-site meteorology. Such options may include obtaining/developing a gridded meteorological database based on MM5 output meteorological data fields modified by CALPUFF simulations using existing real world meteorological data (e.g., Robey Greene, Asheville, etc.). This "representative" meteorological database combined with site-specific terrain topographic and land-use data could then be used by CALPUFF or AERMOD to evaluate facility impacts anywhere in western North Carolina. While technically considered a screening modeling methodology due to lack of site-specific meteorology, this approach would take advantage of the refined model enhancements and complex terrain capabilities incorporated in CALPUFF and AERMOD. Such an approach would significantly reduce complex terrain modeling uncertainties associated with screening models such as SCREEN3 or CTSCREEN and provide a higher level of confidence that modeled maximum impacts would be less than the applicable air quality standards.

Figure 1



NORTH
SOUTH
WEST
EAST
6%
12%
18%
24%
30%
Wind Speed m/s
> 11.06
8.49 - 11.06
5.40 - 8.49
3.34 - 5.40
1.80 - 3.34
0.51 - 1.80
MODELER
Stn 1(Valley)
DATE
3/23/01
DISPLAY
Wind Speed
UNIT
m/s
AVG. WIND SPEED
2.71 m/s
CALM WINDS
41.20%
ORIENTATION
Direction
(blowing from)
Nov 1999
thru
Oct 2000

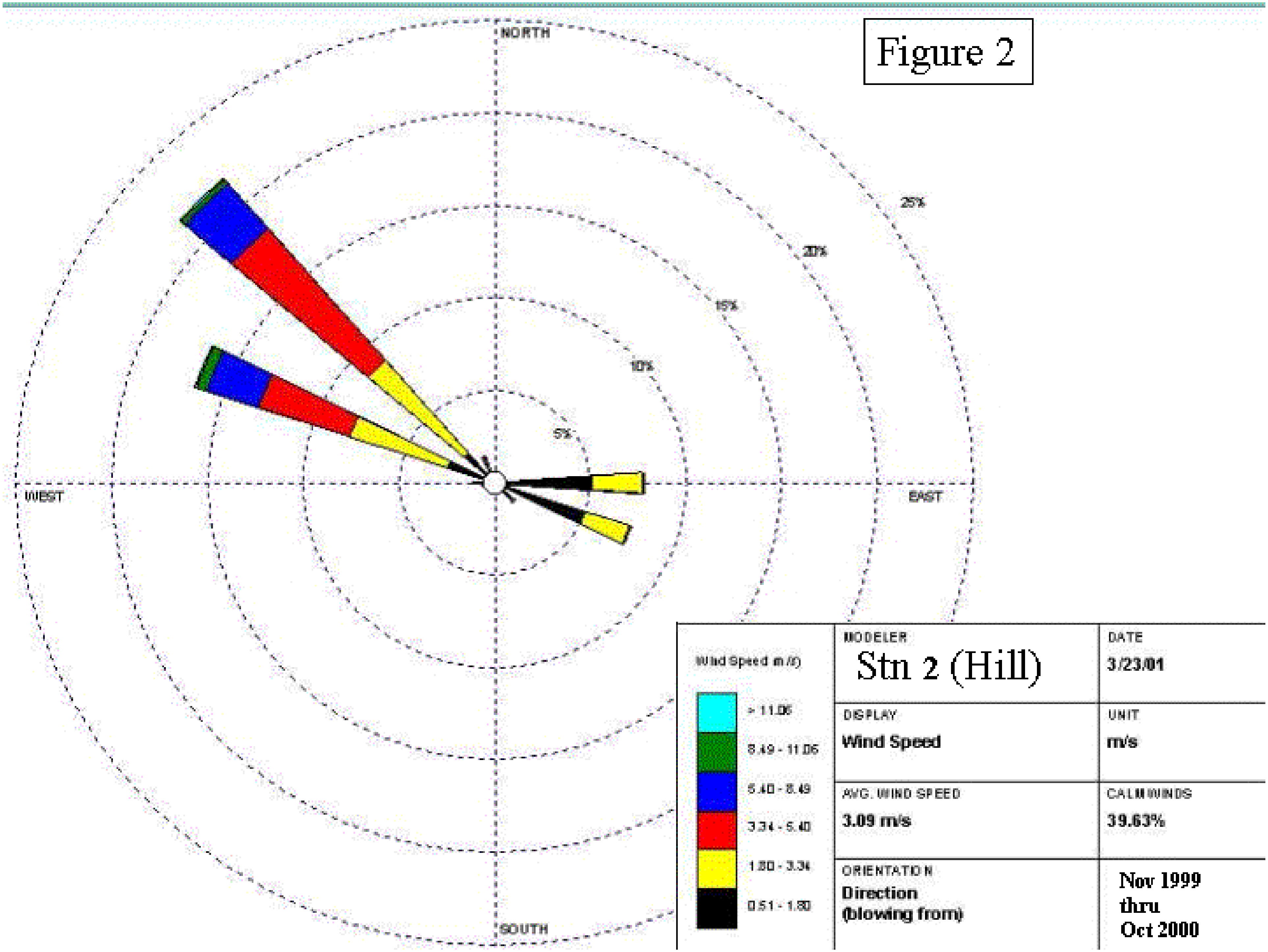

NORTH
WEST
EAST
SOUTH
5%
10%
15%
20%
25%
Wind Speed m/s)
> 11.06
8.49 - 11.06
5.40 - 8.49
3.34 - 5.40
1.80 - 3.34
0.51 - 1.80
MODELER
Stn 2 (Hill)
DATE
3/23/01
DISPLAY
Wind Speed
UNIT
m/s
AVG. WIND SPEED
3.09 m/s
CALM WINDS
39.63%
ORIENTATION
Direction
(blowing from)
Nov 1999
thru
Oct 2000

Figure 2

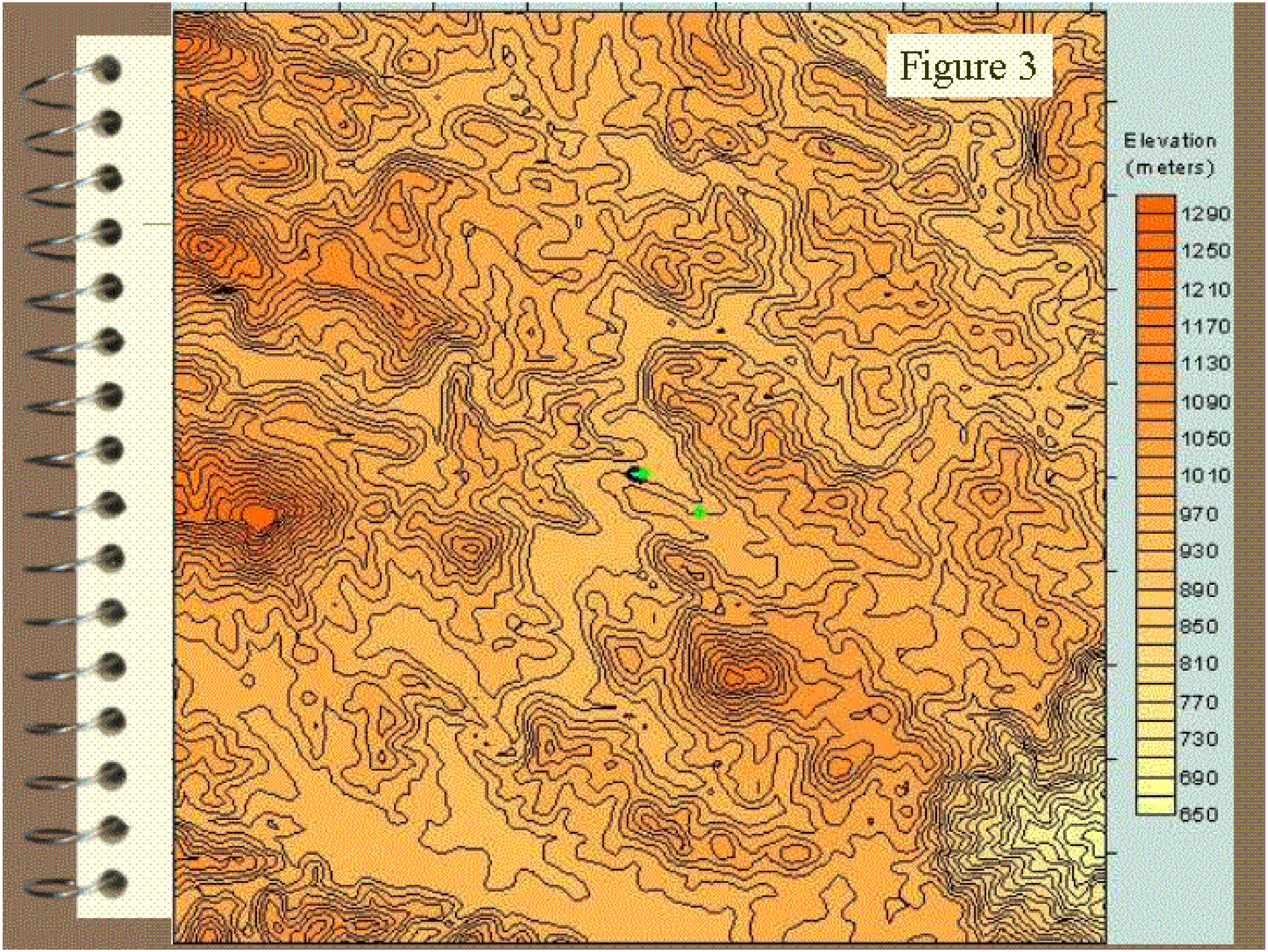


Figure 3
Elevation
(meters)
1290
1250
1210
1170
1130
1090
1050
1010
970
930
890
850
810
770
730
690
650

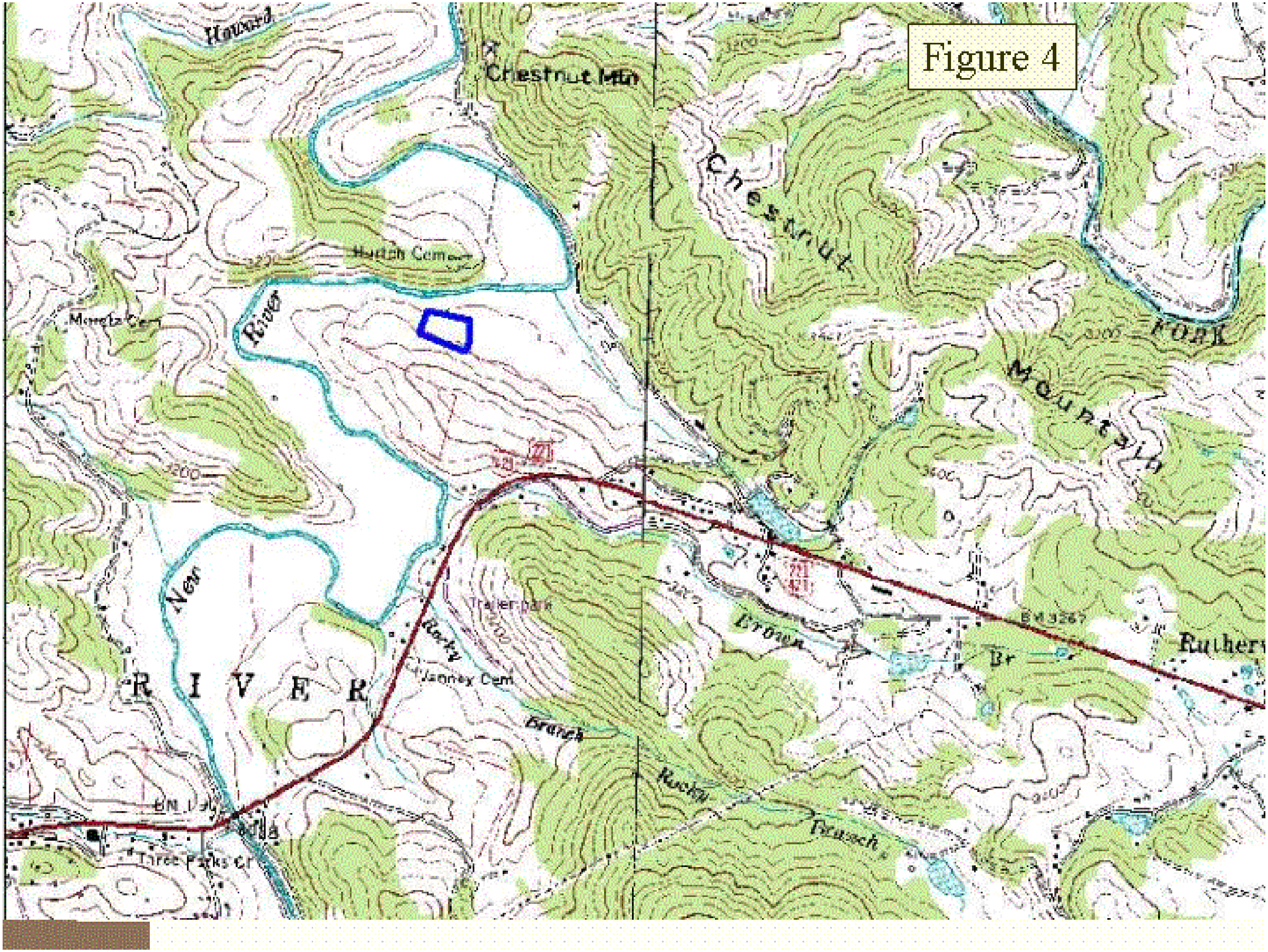
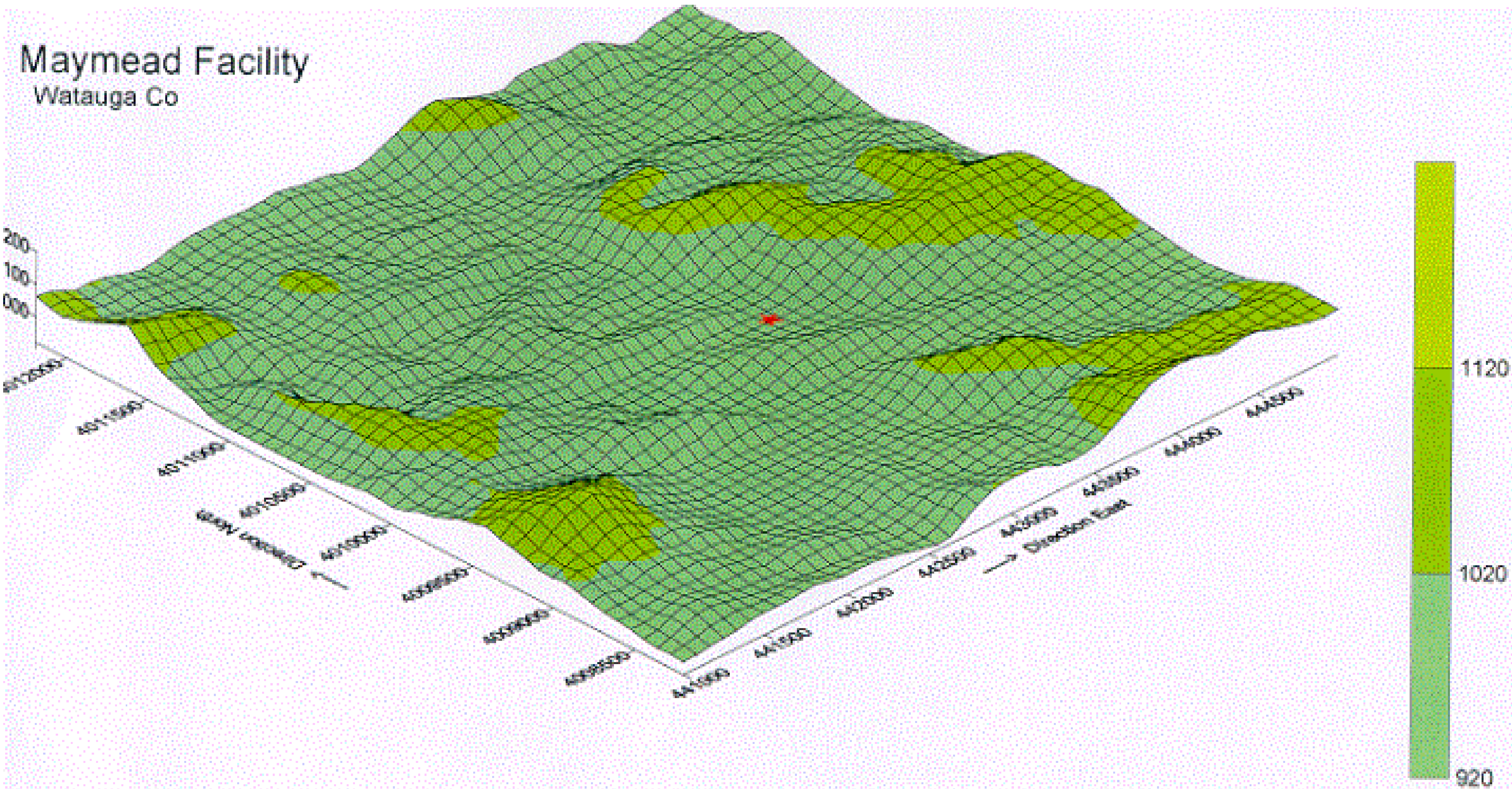


Figure 4
Howard
Chestnut Mtn
Chestnut
Mountain
FORK
River
New
R I V E R
Trailer park
Rocky
Branch
Brown
Br
Rocky
Branch
Three Forks Ch
Rutherw

Figure 5



Maymead Facility
Watauga Co
Direction North
Direction East
1120
1020
920

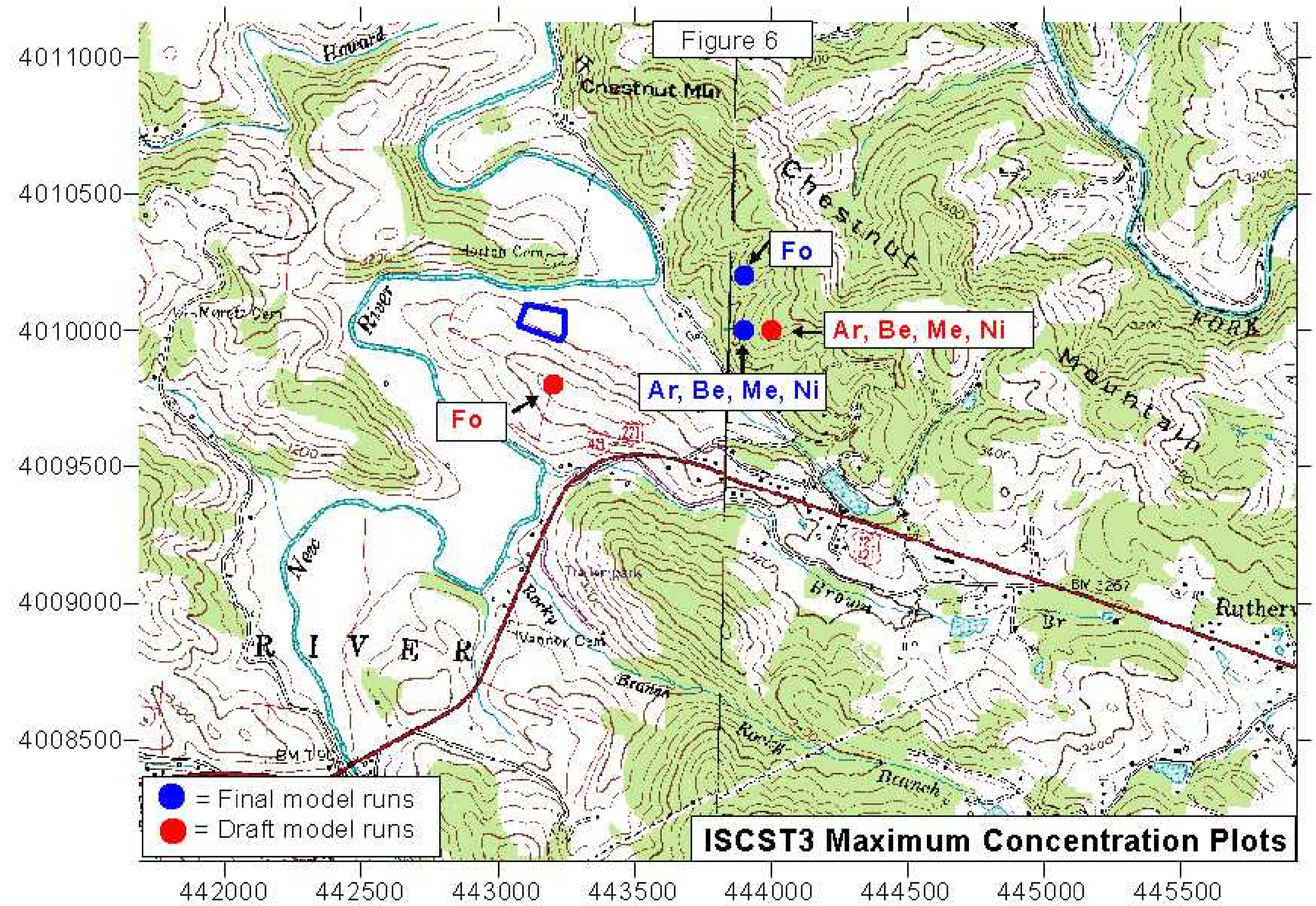


Figure 6
Fo
Ar, Be, Me, Ni
Ar, Be, Me, Ni
Fo
= Final model runs
= Draft model runs
ISCST3 Maximum Concentration Plots
4011000
4010500
4010000
4009500
4009000
4008500
442000
442500
443000
443500
444000
444500
445000
445500
Chestnut Mtn
Chestnut Mountain
River
New
RIVER
Rocky Branch
Brown Br
Trailer park
Vannoy Cem
BM 3257

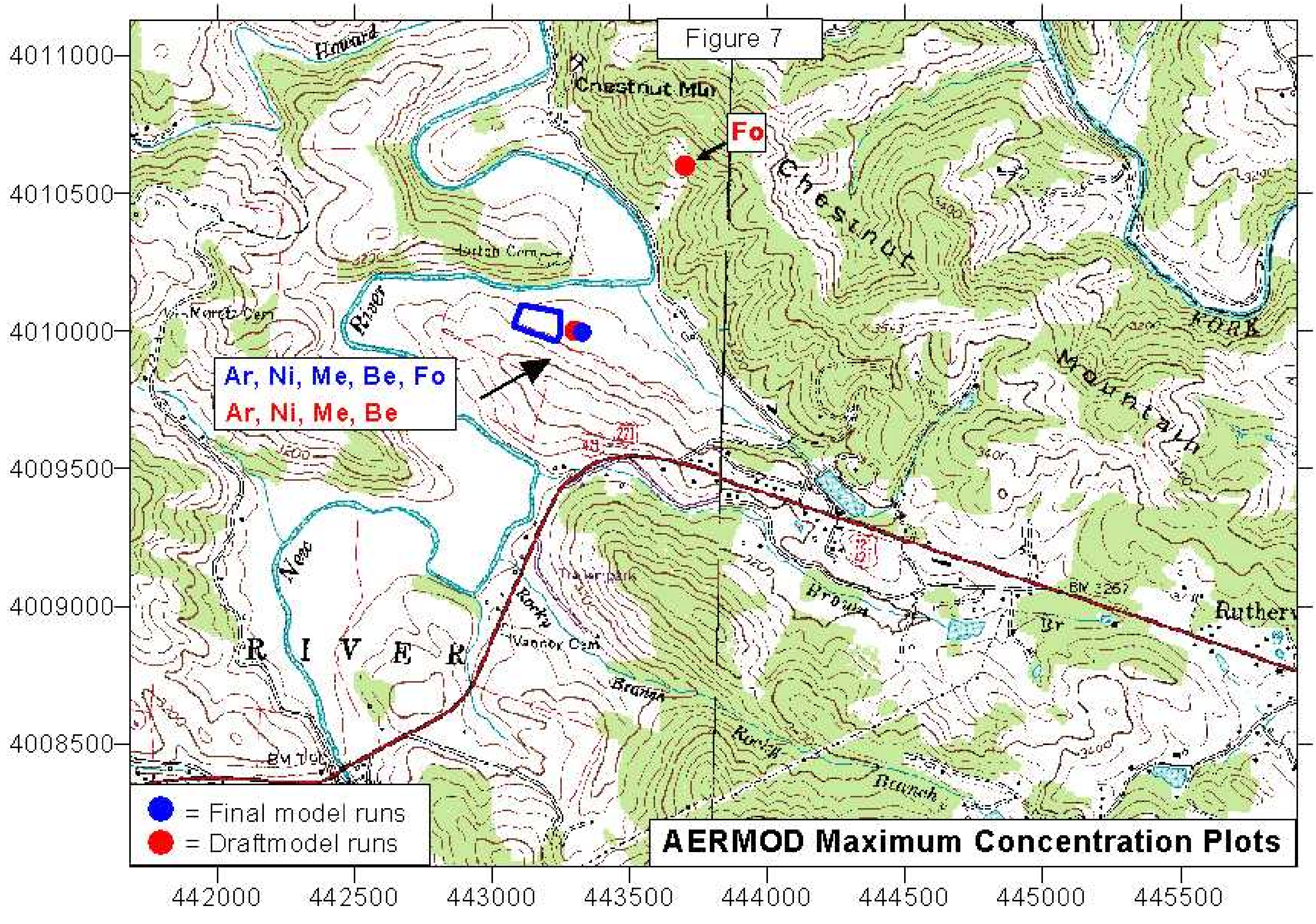


Figure 7
Fo
Ar, Ni, Me, Be, Fo
Ar, Ni, Me, Be
= Final model runs
= Draftmodel runs
AERMOD Maximum Concentration Plots
4011000
4010500
4010000
4009500
4009000
4008500
442000
442500
443000
443500
444000
444500
445000
445500
Chestnut Mtn
Chestnut
Mountain
FORK
River
New
R I V E R
Rocky
Vannoy Cem
Branch
Brown
Br
Trailer park
Howard
Rutherw

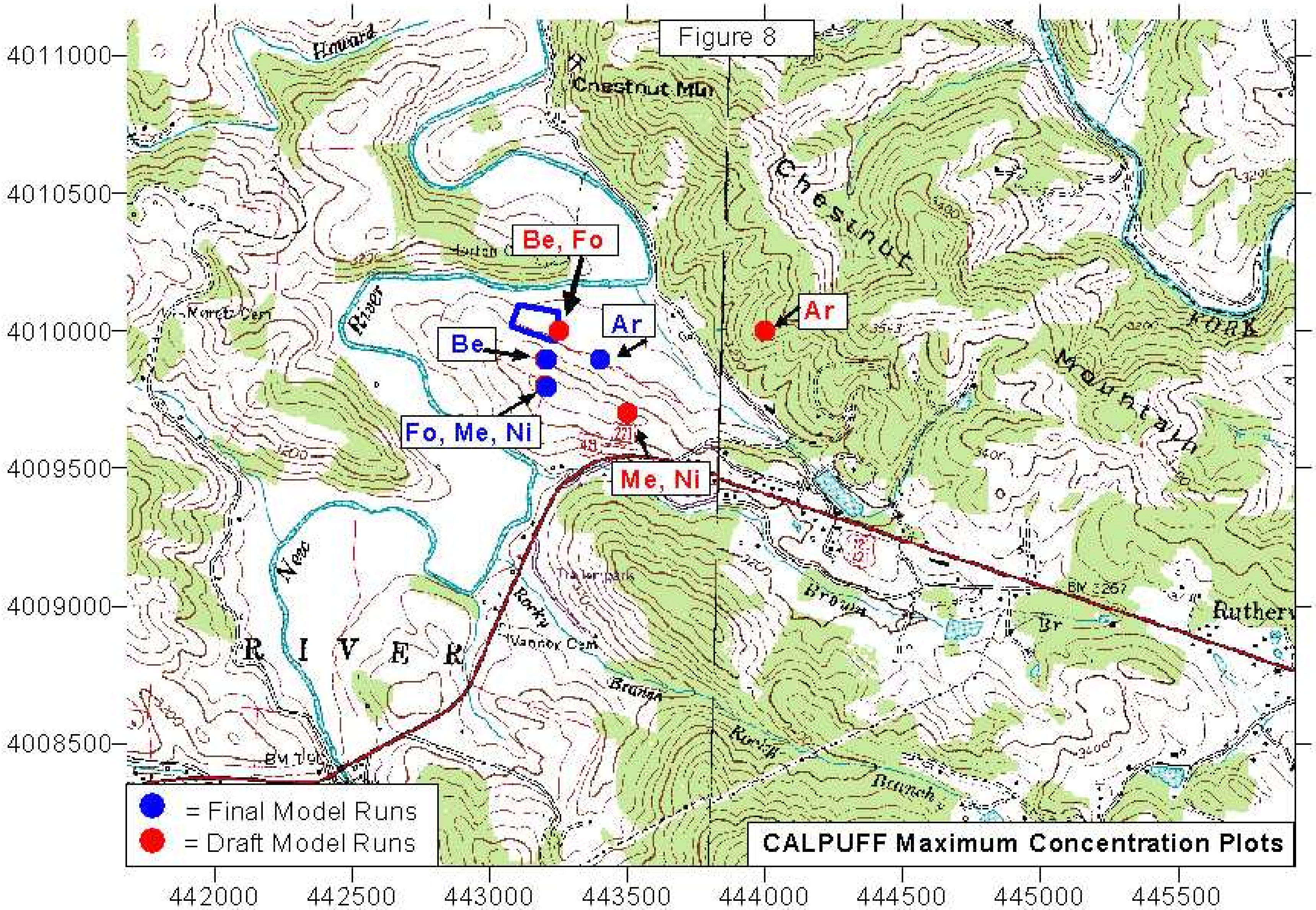


Figure 8
Be, Fo
Ar
Be
Ar
Fo, Me, Ni
Me, Ni
= Final Model Runs
= Draft Model Runs
CALPUFF Maximum Concentration Plots
4011000
4010500
4010000
4009500
4009000
4008500
442000
442500
443000
443500
444000
444500
445000
445500
Chestnut Mtn
Chestnut
Mountain
FORK
New
River
R I V E R
Rocky
Trailer park
Vannoy Cem
Branch
Brown
Br
Rutherf
Howard
BM 3257
BM 1101

Hot Mix Asphalt Manufacture

Plant Name & Other Notes: Proposed Capacity for Maymead Roby Green Site
150 tph Drum; 300,000 tpy; No. 2 oil

Choose Plant Type:	**1** (1=Drum, 2=Batch)	Source Subject to NSPS? (Y/N)	**y**
		if yes: ACFM	**25,727**
Annual Throughput (TPY):	**300,000**	Temp (F)	**400**
Hourly Throughput (TPH):	**150**	Moisture (%)	**23**
Heat Input Capacity (Million Btu/hr)	**36.62**	Fuel Type	**2**
Fuel Oil Sulfur Content (%):	**0.5**	(1 = Natural Gas, 2 = No. 2 fuel oil, 3 = No.4 fuel oil, and 4 = 5 & 6 fuel oils)	
[The Sulfur content of No. 2 Fuel oil is 0.5% by Default]		Is Waste Oil Fired? (Y/N)	**n**

Criteria Pollutants

Pollutant	TPY	lb/hr
Uncontrolled Total PM	4,200	4,200.00
Allowable PM per 2D .0506	44.3	44.30
Allowable PM per 2D .0524	4.2	4.17
Uncontrolled Total PM-10	975	975.00
Carbon Monoxide	19.5	19.5
Nitrogen Oxides	8.3	8.3
Sulfur Dioxide	9.77	9.77
Volatile Organic Compounds	4.8	4.80
Lead	2.3E-03	2.3E-03

Compliance Control Efficiency	
98.95	for 2D .0506
99.90	for NSPS

NCDENR

Toxic Air Pollutants

TAP	lb/yr	lb/hr
Acetaldehyde	NA	NA
Acrolein	NA	NA
Arsenic	1.68E-01	8.40E-05
Benzene	1.170E+02	5.85E-02
Benzo(a)pyrene	2.94E-03	1.47E-06
Beryllium	NA	NA
Cadmium	1.23E-01	6.15E-05
Chromic Acid	1.35E-01	6.75E-05
Formaldehyde	9.30E+02	4.65E-01
2,3,7,8 TCDD	6.30E-08	3.15E-11
1,2,3,6,7,8 HCDD	3.90E-07	1.95E-10
n-Hexane	2.76E+02	1.38E-01
hydrogen chloride	NA	NA
Manganese	2.31E+00	1.16E-03
Methyl Chloroform	1.44E+01	7.20E-03
Methyl Ethyl Ketone	NA	NA
Mercury	7.80E-01	3.90E-04
Nickel	1.89E+01	9.45E-03
Toluene	8.70E+02	4.35E-01
Xylene	6.00E+01	3.00E-02

December 2000 Final Emission Factors from Section 11.1 AP-42

Toxic and Hazardous Air Pollutants Based on Fabric Filter Control (99.9% to 99.99+%).

Sulfur Dioxide Emissions are Derived from AP-42 Sections 1.3 (fuel oil) and 1.4 (nat gas) and are valid for heat inputs less than 100 million Btu per hour. (revisions 9/98 and 7/98, respectively). The factors for fuel oil are adjusted to account for 50% of fuel bound sulfur that will be retained in the product (upto 0.1 lb/ton) per footnote "c" of Table 11.1-5.

Hexavalent Chromium is reported as Chromic Acid per Toxics Branch Guidance.

Asphaltic Concrete Handling TAP Emissions

Plant Name & Other Notes: Proposed Capacity for Maymead Roby Green Site

150 tph Drum; 300,000 tpy; No. 2 oil

Annual Capacity (TPY)	300,000	Hourly Capacity (TPH)	150
Asphalt Temperature (F)	325	Volatility Loss (%)	0.5

Calculation of TAPS from December 2000 AP-42 Final Emission Factors (Table 11.1-15,16)
Default V (asphalt volatility) = 0.5 percent loss (-0.5)
Default T (asphalt temperature) = 325F

Loadout TOC (lb/ton) = 0.0172(-V)exp((0.0251)(T+460)-20.43) = 4.16E-3 lb/ton
Loadout Organic PM (lb/ton) = 0.00141(-V)exp((0.0251)(T+460)-20.43) = 3.41E-4 lb/ton
Silo filling TOC (lb/ton) = 0.0504(-V)exp((0.0251)(T+460)-20.43) = 1.22E-2 lb/ton

Criteria Pollutant	Emission Rate (lb/yr)		Emission Rate (lb/hr)	
	Loadout	**Silo Fill**	**Loadout**	**Silo Fill**
Particulate Matter	1.57E+02	1.76E+02	7.83E-02	8.79E-02
Carbon Monoxide	4.05E+02	3.54E+02	2.02E-01	1.77E-01
Volatile organic Compounds	1.17E+03	3.66E+03	5.86E-01	1.83E+00

TAP	Emission Rate (lb/yr)		Emission Rate (lb/hr)	
	Loadout	**Silo Fill**	**Loadout**	**Silo Fill**
Benzene	6.49E-01	1.17E+00	3.24E-04	5.85E-04
Benzo(a)pyrene (Organic PM)	2.35E-03	ND	1.18E-06	ND
Carbon Disulfide	1.62E-01	5.85E-01	8.11E-05	2.92E-04
Formaldehyde	1.10E+00	2.52E+01	5.49E-04	1.26E-02
n-Hexane	1.87E+00	3.66E+00	9.36E-04	1.83E-03
Methyl Ethyl Ketone	6.11E-01	1.43E+00	3.06E-04	7.13E-04
Methylene Chloride	ND	9.87E-03	ND	4.94E-06
Phenol (Organic PM)	1.21E+00	ND	6.03E-04	ND
Styrene	9.11E-02	1.97E-01	4.55E-05	9.87E-05
Tetrachloroethene	9.61E-02	ND	4.80E-05	ND
Toluene	2.62E+00	2.27E+00	1.31E-03	1.13E-03
TrichloroFluoroMethane	1.62E-02	ND	8.11E-06	ND
Xylene	6.11E+00	9.40E+00	3.06E-03	4.70E-03

HMA2001 Summary Table

Plant Name & Other Notes: Proposed Capacity for Maymead Roby Green Site

150 tph Drum; 300,000 tpy; No. 2 oil

Criteria Pollutants

Pollutant	TPY	lb/hr
Total PM	4.42	4.35
Total PM-10	4.38	4.35
Carbon Monoxide	20.1	19.93
Nitrogen Oxides	9.1	8.44
Sulfur Dioxide	12.68	10.44
Volatile Organic Compounds	7.2	7.22
Lead	2.3E-03	2.3E-03

Toxic Air Pollutants

TAP	lb/yr	lb/hr
Acetaldehyde	NA	NA
Acrolein	NA	NA
Arsenic	1.68E-01	8.40E-05
Benzene	1.19E+02	5.94E-02
Benzo(a)pyrene	5.29E-03	2.65E-06
Beryllium	NA	NA
Cadmium	1.23E-01	6.15E-05
Carbon Disulfide	7.47E-01	3.74E-04
Chromic Acid	1.35E-01	6.75E-05
Formaldehyde	9.56E+02	4.78E-01
2,3,7,8 TCDD	6.30E-08	3.15E-11
1,2,3,6,7,8 HCDD	3.90E-07	1.95E-10
n-Hexane	2.82E+02	1.41E-01
hydrogen chloride	NA	NA
Manganese	2.31E+00	1.16E-03
Methyl Chloroform	1.44E+01	7.20E-03
Methyl Ethyl Ketone	2.04E+00	1.02E-03
Methylene Chloride	9.87E-03	4.94E-06
Mercury	7.80E-01	3.90E-04
Nickel	1.89E+01	9.45E-03
Phenol (Organic PM)	1.21E+00	6.03E-04
Styrene	2.89E-01	1.44E-04
Tetrachloroethene	9.61E-02	4.80E-05
Toluene	8.75E+02	4.37E-01
TrichloroFluoroMethane	1.62E-02	8.11E-06
Xylene	7.55E+01	3.78E-02

NCDENR

No. 2 fuel oil Fired Asphalt Tank Heater

Heat input (million Btu/hour) **1.31**

(assumes 8,760 hr/yr & 0.5% S in Fuel)

Pollutant Emission Rate

	lb/yr	lb/hr
PM	163.9	0.02
PM-10	90.2	0.01
SO_2	5,819.8	0.66
NOx	1,639.4	0.19
CO	409.8	0.05
VOC	27.9	0.00

[AP-42 Section 1.3 (9/98)]

Disclaimer: The Division of air Quality is not responsible for any errors or omissions contained in this spreadsheet. It is the applicant's responsibility to ensure that emission estimates and compliance demonstrations based on these estimates are correct.

Attachment 2: Summary of Modeling Results

Ambient Concentrations (mg/m3) / % of AAL											
			Screen			Draft - Refined			Final - Refined		
Pollutant	Averaging Period	AAL	SCREEN3 (1)	SCREEN3 (2)	SCREEN3 (3)	ISCST3 (4)	AERMOD (4)	CALPUFF (4)	ISCST3 (5)	AERMOD (5)	CALPUFF (5)
Arsenic	Annual	2.30E-07	5.70E-08	1.46E-08	3.26E-08	3.00E-08	1.41E-08	3.04E-09	1.76E-08	9.86E-09	5.03E-09
			24.78%	6.35%	14.17%	13.04%	6.13%	1.32%	7.65%	4.29%	2.19%
Benzene	Annual	1.20E-04	2.50E-05	7.55E-05	1.33E-04	1.80E-05	1.39E-05	3.09E-05	1.11E-05	9.12E-06	2.05E-05
			20.83%	62.92%	110.83%	15.00%	11.58%	25.75%	9.25%	7.60%	17.08%
Formaldehyde	1-Hour	1.50E-01	1.30E-01	1.55E-02	2.69E-02	1.28E-02	4.25E-03	4.59E-02	7.29E-03	3.20E-03	1.33E-02
			86.67%	10.33%	17.93%	8.53%	2.83%	30.60%	4.86%	2.13%	8.87%
Mercury	24-Hour	6.00E-04	---	5.00E-06	2.65E-06	2.00E-06	1.75E-06	1.48E-06	6.00E-07	7.60E-07	1.34E-06
				0.83%	0.44%	0.33%	0.29%	0.25%	0.10%	0.13%	0.22%
Nickel	24-Hour	6.00E-03	---	1.53E-04	6.43E-05	4.84E-05	4.23E-05	3.59E-05	1.47E-05	1.85E-05	3.25E-05
				2.55%	1.07%	0.81%	0.71%	0.60%	0.25%	0.31%	0.54%

(1) Original SCREEN3 results submitted in May 1998 and based on existing AP-42 emission factors and DAQ testing.

(2) Revised SCREEN3 results based on EPA Mar 2000 emission factors

(3) Revised SCREEN3 results based on EPA Dec 2000 emission factors

(4) Model results based on EPA Dec 2000 emission factors and one year of onsite data

(5) Model results based on EPA Dec 2000 emission factors, one year of onsite data, and limited facility operations of Apr thru Oct, 7am - 7pm